UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/674,568	09/29/2003	Matthew Fenton Davis	6716/ETCH/SILICON	3852

44257 7590 09/23/2005

PATTERSON & SHERIDAN, LLP
3040 POST OAK BOULEVARD, SUITE 1500
HOUSTON, TX 77056

EXAMINER	
KACKAR, RAM N	

ART UNIT	PAPER NUMBER
1763	

DATE MAILED: 09/23/2005

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No.	Applicant(s)	
	10/674,568	DAVIS ET AL.	
	Examiner	Art Unit	
	Ram N. Kackar	1763	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *29 September 2003*.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-4,6-21,23-33 and 35-49* is/are pending in the application.

4a) Of the above claim(s) *35-49* is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-4,6-21 and 23-33* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☒ Claim(s) *1-4,6-21,23-33 and 35-49* are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☒ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) Paper No(s)/Mail Date 2.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____.
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other: _____.

DETAILED ACTION

Election/Restrictions

1. Restriction to one of the following inventions is required under 35 U.S.C. 121:

I. Claims 1-4, 6-21, 23-33 and 48-49, drawn to a method, classified in class 216, subclass 59.

II. Claims 35-47, drawn to an apparatus, classified in class 156, subclass 345.25.

2. Inventions I and II are related as process and apparatus for its practice. The inventions are distinct if it can be shown that either: (1) the process as claimed can be practiced by another materially different apparatus or by hand, or (2) the apparatus as claimed can be used to practice another and materially different process. (MPEP § 806.05(e)). In this case the apparatus could be used for any plasma processing like deposition, heat treatment, inspection and metrology.

3. This application further contains claims directed to the following patentably distinct species of the claimed invention related to group II:

Specie A directed to a method of pre-etch measurement and detection of end point in-situ.

Specie B directed to a specific algorithm related to in-situ metrology.

Applicant is required under 35 U.S.C. 121 to elect a single disclosed specie for prosecution on the merit to which the claims shall be restricted if no generic claim is finally held to be allowable. Currently no claim is generic to these species.

4. Because these inventions are distinct for the reasons given above and have acquired a separate status in the art as shown by their different classification, restriction for examination purposes as indicated is proper.

5. During a telephone conversation with Mr. Keith Taboada on 9/9/2005 a provisional election was made with traverse to prosecute the invention of Group I species A, claims 1-4, 6-21, 23-33. Affirmation of this election must be made by applicant in replying to this Office action. Claims 35-49 are withdrawn from further consideration by the examiner, as being drawn to a non-elected invention.

6. Applicant is reminded that upon the cancellation of claims to a non-elected invention, the inventorship must be amended in compliance with 37 CFR 1.48(b) if one or more of the currently named inventors is no longer an inventor of at least one claim remaining in the application. Any amendment of inventorship must be accompanied by a request under 37 CFR 1.48(b) and by the fee required under 37 CFR 1.17(i).

Claim Rejections - 35 USC § 102

7. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

> A person shall be entitled to a patent unless –
>
> (b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

8. Claims 1, 3-4, 6-7, 17-18, 20, 23-24 are rejected under 35 U.S.C. 102(b) as being anticipated by Anthony J. Toprac (US 6379980) as evidenced by Robert John Wilby (US patent publication 2003/0141572).

Anthony J. Toprac discloses a method of monitoring an etch process and discloses pre-etch measurement (Fig 3-310 and Fig 1- 100, 120) by pre-etch metrology tool (120) this data is transferred to process controller (150) which monitors the etch process in cooperation with the

etching tool (130) and end point monitor (140) which is basically a spectrometer (Col 3 line 32-Col 5 line 9). Anthony J. Toprac further teaches that the etch process monitor allows etching to a certain end point time to a predetermined depth and monitor for remaining thickness after removal (Col 4 lines 53 to Col 5 line 9). The pre-etch metrology tool disclosed is a commercially available tool using optical ellipsometry or reflectometry (See Robert John Wilby US patent publication 2003/0141572 paragraph 0099).

Regarding claim 18 mask trim is a regular etch process using reactants known to one of ordinary skill in the art.

Regarding claim 20, the process disclosed above is applicable to photoresist patterned masks as is well known in the art.

9. Claims 1, 3-4, 6-9, 11-13, 15, 17-18, 20, 23-26, 28-30 and 32 are rejected under 35 U.S.C. 102(b) as being anticipated by Klippert II et al (US 6136712).

Klippert II et al disclose a method of monitoring an etch process and discloses pre-etch measurement (Col 4 line 64-Col 5 line 1) before starting an etch process which is further monitored by the etch process monitor to allows etching to a certain end point time to a predetermined depth and monitor for remaining thickness after removal (abstract). The pre-etch metrology tool for thickness measurement and during etching process monitoring is disclosed to be through commercially available metrology systems employing interferometric measurement and monitoring techniques (Col 4 line 45 to Col 5 line 30).

10. Claims 1, 3-4, 6-9, 11-13, 15, 17-18, 20, 23-26, 28-30 and 32 are rejected under 35 U.S.C. 102(b) by Petrucci et al (WO 01/24254 A1) or alternately under 35 U.S.C. 102(e) as being anticipated by Petrucci et al (US publication 2003/0010750).

Petrucci et al disclose a method of monitoring an etch process and discloses pre-etch measurement (Paragraph 18) before starting an etch process which is further monitored by the etch process monitor to allows etching to a certain end point time to a predetermined depth and monitor for remaining thickness after removal (abstract). The pre-etch metrology tool for thickness measurement is disclosed to be through preferably a laser system based on ellipsometry (Paragraph 20) and during etching process monitoring employing interferometric measurement and monitoring techniques (Paragraph 5).

11. **Claims 1, 3-4, 6-9, 11-13, 15, 17-18, 20, 23-26, 28-30 and 32 are rejected under 35 U.S.C. 102(b) as being anticipated by Grimbergen et al (US 6390019).**

Grimbergen et al disclose a method of monitoring an etch process and discloses pre-etch measurement (Col 13 lines 17-25) before starting an etch process which is further monitored by the etch process monitor to allows etching to a certain end point time to a predetermined depth and monitor for remaining thickness after removal (abstract). The pre-etch metrology tool for thickness measurement is disclosed to be a commercial system using reflectance thickness measurement system and during etching process monitoring employing interferometric or ellipsometry measurement and monitoring techniques (Col 7 line 60-Col 8 line30).

Claim Rejections - 35 USC § 103

12. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

13. Claims 2 and 19 are rejected under 35 U.S.C. 102(b) as being unpatentable over Anthony J. Toprac (US 6379980) in view of John H. Payne (US 5329381).

Anthony J. Toprac discloses a method of pre-etch measurement (Fig 3-310 and Fig 1-100, 120) by pre-etch metrology tool (120) this data is transferred to a process controller (150) which monitors the etch process in cooperation with the etching tool (130) and end point monitor (140).

Toprac however does not disclose the details of the measurement techniques and specially noise elimination for the accuracy of the measurement.

John H. Payne discloses special filter to remove outliers (these are erroneous data points lying outside good data points) and teaches that this is a nonlinear noise-cleaning filter (Col 8 lines 17-24).

Therefore it would have been obvious for one of ordinary skill in the art at the time of invention to have used outlier filter to remove noise in order to improve the accuracy of measurement of pre-etch.

14. Claims 10, 20 and 27 are rejected under 35 U.S.C. 102(b) as being unpatentable over Anthony J. Toprac (US 6379980) in view of Bin Yu (US 6368982).

Anthony J. Toprac discloses a method of monitoring an etch process in cooperation with the etching tool (130) and end point monitor (140) which is basically a spectrometer (Col 3 line 32- Col 5 line 9). Anthony J. Toprac further teaches that the etch process monitor allows etching to a certain end point time to a predetermined depth and monitor for remaining thickness after removal (Col 4 lines 53 to Col 5 line 9).

Anthony J. Toprac does not disclose measurement of features such that horizontal etch and vertical etch accuracy could be validated from measurement of each other.

Bin Yu discloses a method of mask trim and discloses that the mask undergoes etching from all sides and leaves a scaled down length and discloses that the two sides and the top are trimmed by substantially the same trim length (Fig 1to Fig 3 and Col 1 line 50- Col 2 line5).

Therefore it would have been obvious for one of ordinary skill in the art at the time of invention to have used correlation between horizontal etch and vertical etch to validate the accuracy of trim during trim etch.

15. Claims 14 and 31 are rejected under 35 U.S.C. 102(b) as being unpatentable over Klippert II et al (US 6136712) in view of Nakada et al (JP 11-251252).

Klippert II et al disclose a method of monitoring an etch process and discloses pre-etch measurement (Col 4 line 64-Col 5 line 1) before starting an etch process which is further monitored by the etch process monitor to allows etching to a certain end point time to a predetermined depth and monitor for remaining thickness after removal (abstract). The pre-etch

metrology tool for thickness measurement and during etching process monitoring is disclosed to be through commercially available metrology systems employing interferometric measurement and monitoring techniques (Col 4 line 45 to Col 5 line 30).

Klippert II et al do not disclose modulation of the intensity of light for measurement.

Nakada et al disclose that light having a desired wavelength and modulation of intensity is used for monitoring a plasma (Abstract).

Therefore it would have been obvious for one of ordinary skill in the art at the time of invention to use intensity modulation to have better signal/noise ratio as intensity modulation helps to eliminate noise.

16. Claims 16 and 33 are rejected under 35 U.S.C. 102(b) as being unpatentable over Grimbergen et al (US 6390019) in view of Grimbergen et al (US 6406924).

Grimbergen et al disclose a method of monitoring an etch process and discloses pre-etch measurement (Col 13 lines 17-25) before starting an etch process which is further monitored by the etch process monitor to allows etching to a certain end point time to a predetermined depth and monitor for remaining thickness after removal (abstract). The pre-etch metrology tool for thickness measurement is disclosed to be a commercial system using reflectance thickness measurement system and during etching process monitoring employing interferometric or ellipsometry measurement and monitoring techniques (Col 7 line 60-Col 8 line30).

Grimbergen et al in US 6390019 do not disclose correlation between spectrum minima and width of structures formed during etch. However as the structures are etched the minimas

and maxima of the interferometric signal shift since the position of minima and maxima are indicative of etch depth as taught in other patent (US 6406924 – Col 1 line 59-Col 2 line 8).

Therefore it would have been obvious for one of ordinary skill in the art at the time of invention to have used correlation between minima and width of etch to validate the accuracy of trim during trim etch.

17. Claim 21 is rejected under 35 U.S.C. 102(b) as being unpatentable over Anthony J. Toprac (US 6379980) in view of Cha et al (US 6319767).

Anthony J. Toprac discloses a method of monitoring an etch process and discloses pre-etch measurement (Fig 3-310 and Fig 1- 100, 120) by pre-etch metrology tool (120) this data is transferred to process controller (150) which monitors the etch process in cooperation with the etching tool (130) and end point monitor (140) which is basically a spectrometer (Col 3 line 32-Col 5 line 9). Anthony J. Toprac further teaches that the etch process monitor allows etching to a certain end point time to a predetermined depth and monitor for remaining thickness after removal (Col 4 lines 53 to Col 5 line 9). The pre-etch metrology tool disclosed is a commercially available tool using optical ellipsometry or reflectometry (See Robert John Wilby US patent publication 2003/0141572 paragraph 0099).

Anthony J. Toprac does not disclose the mask etch trim process to be a regular plasma etch.

Cha et al disclose that the photoresist mask is reduced by plasma (Col 3 lines 30-35).

Therefore it would have been obvious for one of ordinary skill in the art at the time of invention to have used plasma to reduce photoresist mask produced by lithography to further

reduce by plasma for reduction of feature size of layer etched by using the patterned photoresist mask.

Conclusion

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Ram N. Kackar whose telephone number is 571 272 1436. The examiner can normally be reached on M-F 8:00 A.M to 5:P.M.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Parviz Hassanzadeh can be reached on 571 272 1435. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).



Ram Kackar
Examiner AU 1763